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Integral Benchmark Evaluations (MS-NE-1)

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U.S. Department of Energy

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History of International Criticality Safety Benchmark Evaluation Project (ICSBEP)

- Initiated in October of 1992 by the Department of Energy's Defense Programs – Called the *Criticality Safety Benchmark Evaluation Project (CSBEP)*
- Managed through the Idaho National Laboratory (INL)
- Involved nationally known criticality safety experts
- The CSBEP became an international activity in 1994 when the United Kingdom, France, Japan, Russian Federation, and Hungary joined the effort.
- Mandated through the Organization for Economic Cooperation and Development (OECD) Nuclear Energy Agency's (NEA) Nuclear Science Committee (NSC) in 1995 and was renamed the International Criticality Safety Benchmark Evaluation Project (ICSBEP).

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History of International Reactor Physics Experiment Evaluation Project (IRPhEP)

- Initiated as a pilot activity in 1999 by the OECD NEA Nuclear Science Committee – INL involvement from the beginning
- Endorsed as an official activity of the NSC in June of 2003
- Patterned after its predecessor, the ICSBEP
- Focuses on other integral measurements such as buckling, spectral characteristics, reactivity effects, reactivity coefficients, kinetics measurements, reaction-rate and power distributions, nuclide compositions and other miscellaneous types of measurements in addition to the critical configuration
- Involves internationally known reactor physics experts
- Technical Review Group coordinated through the Idaho National Laboratory (INL) for the OECD NEA

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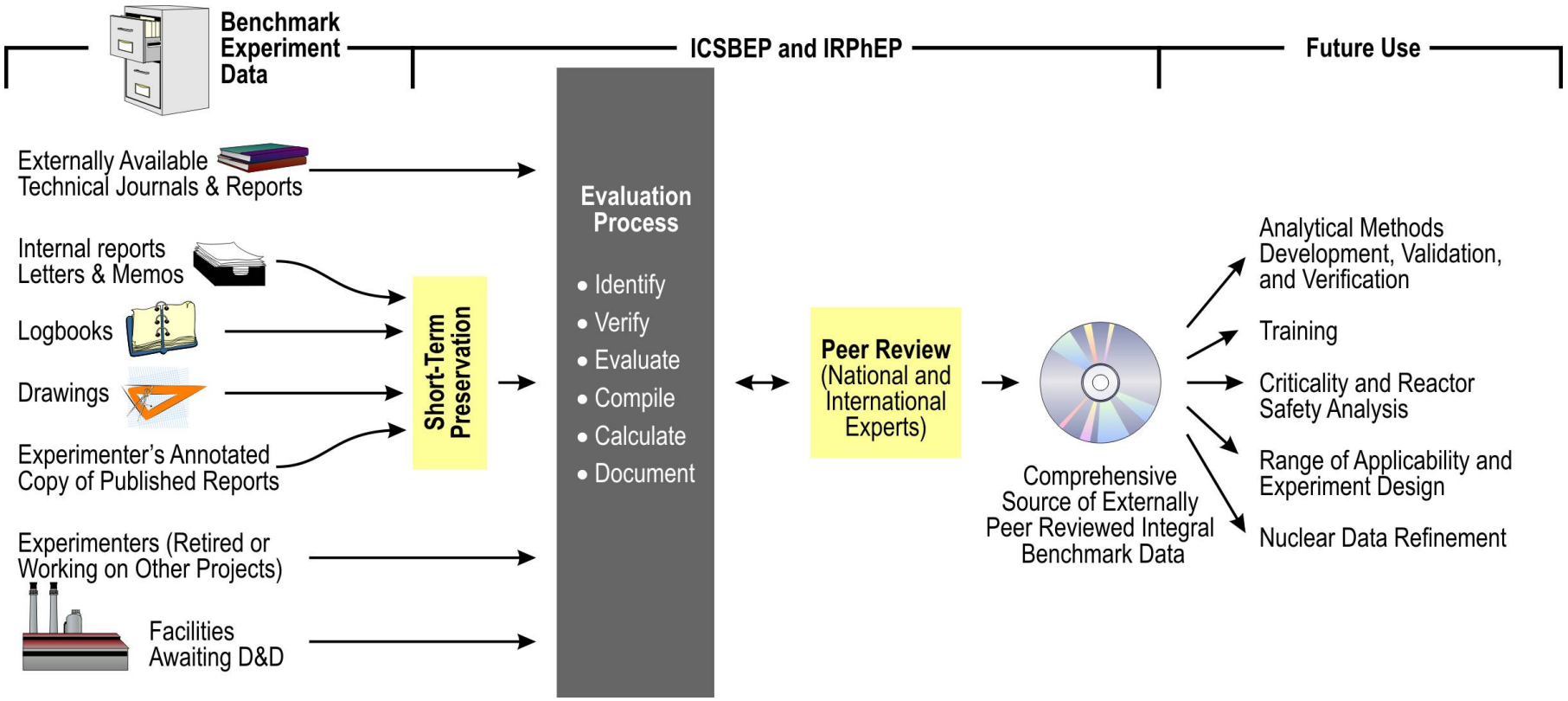
Purpose of the ICSBEP and IRPhEP



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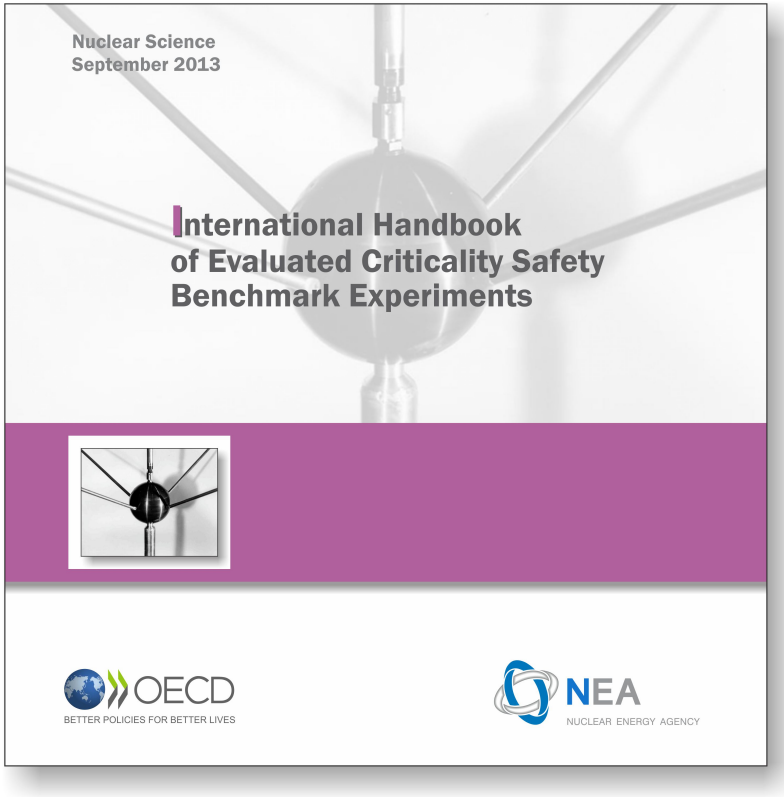
International Handbook of Evaluated Criticality Safety Benchmark Experiments

- **September 2013 Edition**
  - 20 Contributing Countries
  - Spans nearly 67000 Pages
  - Evaluation of 568 Experimental Series
  - 4,798 Critical, Subcritical, or K_∞ Configurations
  - 24 Criticality-Alarm/ Shielding Benchmark Configurations – numerous dose points each
  - 155 fission rate and transmission measurements and reaction rate ratios for 45 different materials



http://www.oecd-nea.org/science/wpncs/icsbep/

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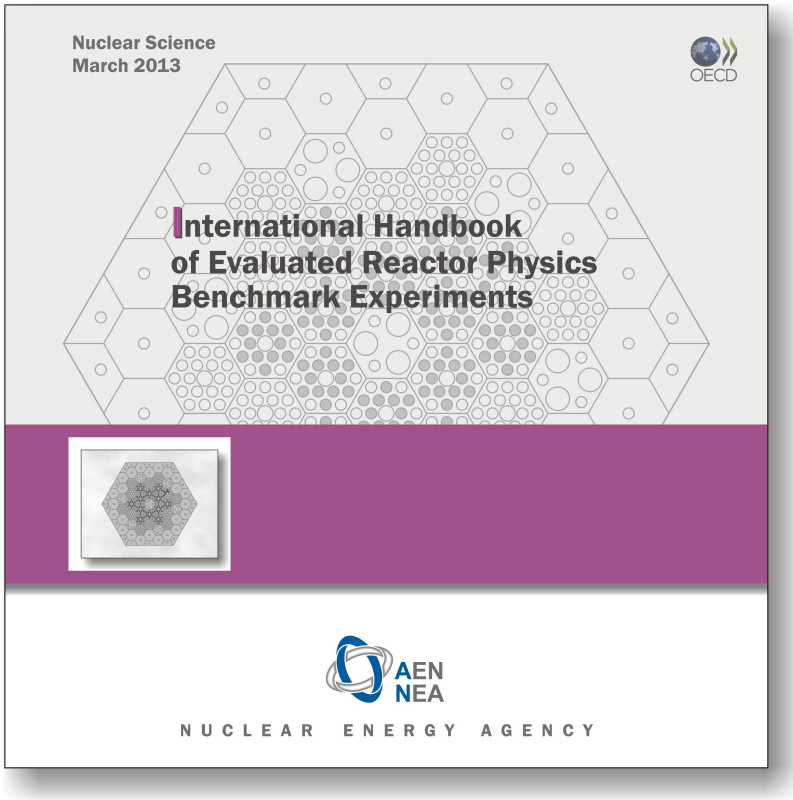
International Handbook of Evaluated Reactor Physics Benchmark Experiments

- **May 2014 Edition**
  - 21 Contributing Countries
  - Data from 135 Experimental Series performed at 48 Reactor Facilities
  - 131 out of the 135 evaluations are published as approved benchmarks
  - Data from 4 out of the 131 series are published in DRAFT form



http://www.oecd-nea.org/science/wprs/irphe/

Accomplishments of ICSBEP & IRPhEP

The work of the ICSBEP and IRPhEP has:

- Highlighted gaps in data
- Retrieved lost data
- Helped to identify deficiencies and errors in cross section processing codes and neutronics codes
- Improved experimental planning, execution and reporting

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Benchmark Evaluation Needs

- **Proposed benchmark evaluations should be of existing data.**

- **Measurements should include:**
  - Critical
  - Subcritical
  - Buckling
  - Spectral characteristics
  - Reactivity effects
  - Reactivity coefficients
  - Kinetics
  - Reaction-rate and power distributions
  - Miscellaneous neutron and gamma measurements

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Sample Benchmark Evaluation Needs

- **Small Modular Reactors**
  - LOFT
  - NS Savannah
  - B&W Spectral Shift Critical Reactor Experiments
- **Boiling Water Reactors**
  - PSI Swiss LWR-PROTEUS Experiments
- **Gas Cooled (Fast and Thermal) Reactors**
  - Fort St. Vrain
  - Peach Bottom
- **Molten Salt Reactors**
  - ORNL Molten Salt Reactor Experiment (MSRE)
  - Hallam Nuclear Power Facility (HNPF)
- **Liquid Metal Fast Reactors**
  - IPPE Russian BFS Experiments
  - Fast Flux Test Facility (FFTF)
  - Experimental Breeder Reactor II (EBR-II)
  - ZPR/ZPPR Experiments

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Sample Benchmark Evaluation Needs

- **Space Reactors**
  - Systems Nuclear Auxiliary Power Program (SNAP)
  - GE-710 Tungsten Cermet Reactor
- **Research Reactors**
  - Various university reactor facilities
  - ORNL High Flux Isotope Reactor (HFIR)
  - Advanced Test Reactor (ATR)
- **Critical Experiments**
  - Intermediate enriched uranium experiments
  - Experiments performed in the epithermal spectra
  - Experiments that test Chlorine absorption
- **Burn-up Credit / Fission Product**
  - STEK Experiments (Netherlands)

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Contact Information

- **Note: While many reactor measurements and critical experiments may not directly support current mainstream DOE programs, they do serve to fill gaps in nuclear data that may be necessary for future programs.**

- **Interested universities may contact INL international benchmark coordination and technical expert John.Bess@inl.gov**